

Issued October 18, 1910.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 416.

THE PRODUCTION OF CIGAR-LEAF TOBACCO IN PENNSYLVANIA.

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WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1910.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., July 18, 1910.

SIR: I have the honor to transmit herewith a manuscript entitled "The Production of Cigar-Leaf Tobacco in Pennsylvania," by Prof. William Frear, Vice-Director and Chemist of the Pennsylvania Agricultural Experiment Station, and Mr. E. K. Hibshman, Collaborator of the Office of Tobacco Investigations, Bureau of Plant Industry. I recommend that this manuscript be published as a Farmers' Bulletin.

Respectfully,

WM. A. TAYLOR,
Acting Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

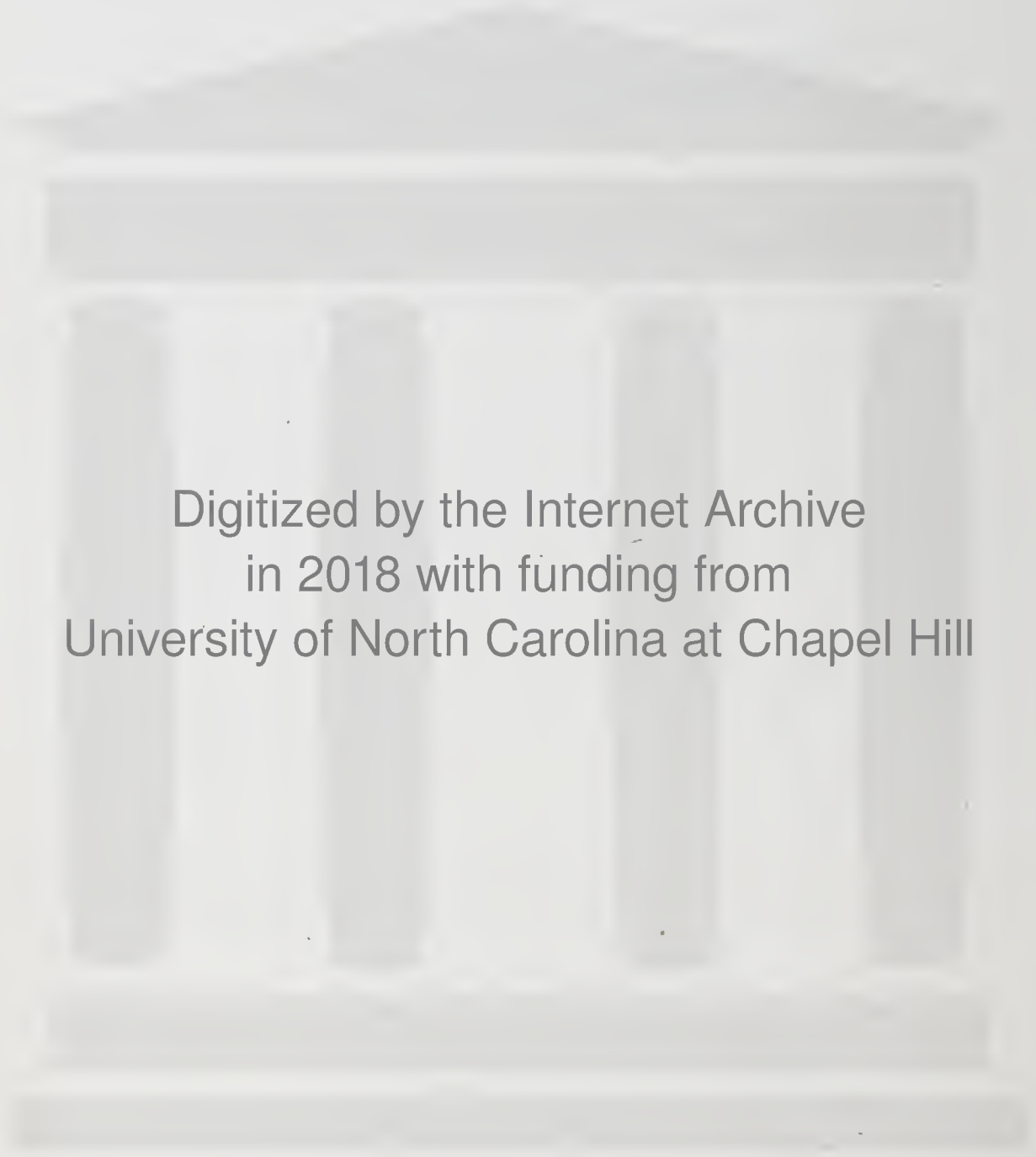
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THE PRODUCTION OF CIGAR-LEAF TOBACCO IN PENNSYLVANIA.^a

INTRODUCTION.

Pennsylvania is one of the four States leading in the production of cigar-leaf tobacco in the United States. The Twelfth Census showed that the leaf was grown upon 9,621 farms of the State and that the total area devoted to the culture was 27,760 acres, with a yield of 41,500,000 pounds, worth nearly \$3,000,000; so that at that time (1900) Pennsylvania ranked third in acreage, yield, and value of tobacco among the cigar-tobacco States.

The Yearbook of the United States Department of Agriculture for 1908 showed that in acreage of cigar-leaf tobacco Pennsylvania ranked below Ohio and Wisconsin, in production second only to Wisconsin, and that in total value of the product Pennsylvania ranked first, while Connecticut, fourth in the particulars first stated, led all the other States in the value per pound of leaf.

CHARACTER OF THE CIGAR-LEAF TOBACCO PRODUCED IN PENNSYLVANIA.

VARIETIES GROWN.

The tobacco produced in Pennsylvania is dark and rather heavy, and therefore useful chiefly as a cigar filler, like that of Ohio, in contrast with that of Wisconsin, which is largely useful for binders, and with that of Connecticut, which is much used for wrappers. When properly fertilized, matured, cured, and sweated, Pennsylvania tobacco is characterized by a mild, agreeable aroma and freedom from bitter, resinous, metallic, and rank flavors, and it burns well, leaving in most cases a coherent white ash. This tobacco blends well in a cigar with a tobacco of more pronounced aroma and flavor, such as the Zimmer, Dutch, or Cuban.

The leaf is produced almost exclusively from local strains of the Connecticut Seedleaf variety, better designated as Pennsylvania

^aThe following Farmers' Bulletins on tobacco may be obtained free of cost upon application to any Member of Congress or to the Secretary of Agriculture: No. 60, Methods of Curing Tobacco; No. 82, The Culture of Tobacco; No. 83, Tobacco Soils; No. 120, Insects Affecting Tobacco; No. 343, The Cultivation of Tobacco in Kentucky and Tennessee.

Broadleaf, and from the Pennsylvania Havana variety, although the latter is now grown much less than formerly. (See figs. 1 and 2.)

INFLUENCE OF THE CLIMATE.

The climate of Pennsylvania peculiarly affects the character of the tobacco produced and is dominant in its influence over those of soil



FIG. 1.—Typical plant of Pennsylvania Havana tobacco.

and heredity, despite the great variety of soils and the wide range of altitudes in the districts where tobacco growing is an important item in the farming industry. No matter what variety of tobacco is introduced, the leaf gradually becomes long and broad in shape, and the flavor and aroma become mild. It is worthy of note that plants of the Zimmer and Dutch varieties obtained from Ohio in practically the same latitude tend to retain their characteristic aroma longer than those grown from Cuban seed, even from the Vuelta Abajo district, which in the new environment, even in the first generation, almost entirely lack their normal aromatic character, although they do not at once assume that of the tobaccos thoroughly acclimated in the State. Yet the top leaves of sheltered Sumatra plants grown on light, sandy soils in a large measure retain in the new environment, even in the fifth generation, their peculiar cinnamon-like aroma and bitter flavor, although the locally characteristic leaf shape develops rapidly in the first generation.

LOCALIZED CONCENTRATION OF TOBACCO CULTURE.

Although tobacco has been grown in Pennsylvania since 1689 and has been produced of satisfactory quality over a large portion of the State on single farms and for a few seasons, the industry is to-day concentrated, as the result of economic causes, in a few regions. Lancaster and York counties lead all others, the former having in 1908 two-thirds of the entire acreage of the State, the latter more than one-seventh. Bradford and Tioga counties form a district standing second, with a combined area of nearly one-ninth of the acreage of the State, while Clinton and Lycoming counties constitute a third district, with one twenty-seventh of the total tobacco acreage of the State. The counties of Berks, Bucks, Chester, Juniata, and Lebanon, adjacent to the Lancaster-York district, produce considerable yields of the leaf and have the same sale centers. In like manner Northumberland County, adjacent to the Clinton-Lycoming district, makes a considerable addition to the total area and product.



FIG. 2.—Typical plant of Pennsylvania Seedleaf, or Broad-leaf, tobacco. The seed head has been covered with a paper bag to prevent cross-fertilization.

SOILS DEVOTED TO TOBACCO CULTURE.

In the Lancaster-York district tobacco is grown chiefly upon limestone soils,^a the Hagerstown loams forming the more northerly belt,

^a See Pennsylvania Agricultural Experiment Station Report, 1894, pp. 136-168.

and the Conestoga loams, in which the presence of damourite or hydromica influences the soil character and in which the phosphoric acid is more abundant, the more southerly belt. The Penn sandy loams of northern Lancaster, derived from the Mesozoic or New Red sandstones of the region, and the sandy alluvium of the Susquehanna islands and the gravelly banks of that river, whose soils are classed as of the Susquehanna series, produce a thinner leaf, more largely useful for binders and wrappers. Indeed, the Penn sandy loams have produced, when covered by shelter, Sumatra-type leaf of excellent wrapper quality, and these localities are still the seat of a considerable culture of the Pennsylvania Havana variety for wrapper purposes, although the greater yields per acre obtained from Connecticut Seedleaf are gradually completing the abandonment of the former variety. It is noteworthy that York County tobacco is generally thought by Lancaster County tobacco packers, who buy it very largely, to require, in fitting it for the use of the cigar maker, a much longer period of case sweating than Lancaster County leaf, otherwise apparently the same, is found to require. Whether this peculiarity is general and whether it is to be attributed to differences in soil or in climate has not yet been ascertained.

In the Bradford-Tioga district, tobacco was first grown upon the river bottoms ^a of the North Branch of the Susquehanna, but for the sake of securing a leaf of thinner texture and smaller vein and rib, the culture has retreated to the higher benches of the river and, in Tioga, has even climbed toward the hilltops. The former soils are sandy loams and in some cases coarse gravels, and will probably be classed with the Susquehanna series unless the glacial origin of part of the alluvial material may lead to a distinctive classification. The soils of Tioga are more largely of glacial formation, but on the hillsides and hilltops, stripped of glacial drift, they may be classed with the new Warren series, although the geological series exposed in Tioga County are not identical with those of Warren and McKean counties. The tobaccos of this district shade in character into those of the adjacent regions of New York State and are largely bought and packed by Elmira and Binghamton packers.

In the Clinton-Lycoming district, tobacco culture is confined almost exclusively to the bottom lands of the West Branch of the Susquehanna River and to those of its principal tributaries, the soils belonging in consequence to the Susquehanna series. In this district a considerable acreage of tobacco was formerly grown on the higher lands of Nittany and Bald Eagle valleys, but its culture has now been discontinued in these localities. The tobaccos of this district are bought

^a An analysis of this soil is given in Pennsylvania Agricultural Experiment Station Report, 1898-9, p. 73.

for packing both by Lancaster and by Elmira packers. While some wrapper leaf is produced in the two districts last considered, the tobacco in general is of the dark, heavy, coarse-veined, filler type.

CULTURAL METHODS.

SIMILARITY OF METHODS USED IN ALL DISTRICTS.

While the three districts previously mentioned are widely separated by broad bands of territory in which tobacco is not grown, the methods of culture prevalent in the several districts are almost identical.

The following account of cultural methods, based chiefly upon Lancaster County practice, applies equally well to the other tobacco-producing districts, although occasional differences in method appearing in the Clinton and Bradford districts will receive mention.

TOBACCO-FARM SYSTEMS.

In Pennsylvania the continuous system of tobacco growing is exceptional. Tobacco generally takes its place in rotation with other crops. On the average farm these include as the principal crops wheat, grass (timothy and clover), corn, and potatoes. A four-year system consisting of (1) wheat, (2) grass, (3) corn, (4) tobacco is generally used, although some growers use a three-year system consisting of (1) wheat, (2) grass, (3) tobacco. In this latter system tobacco follows sod, which is less desirable on account of the increased danger from cutworms, which some seasons badly molest the tobacco grown after sod. During the winter beef cattle are fattened on the corn and roughage grown. The main money crop, however, is tobacco and it has become the most characteristic of Lancaster County crops. Upon this product is based an extensive and highly diversified industry, beginning with the grower and his skilled laborers and extending to the manufacture of finished tobacco products. In the other districts packing establishments are few and cigar manufacturing less extensive.

While many farm owners grow considerable areas of tobacco by the aid of either their own families or hired skilled labor, a large proportion of the crop is raised by tenant farmers or by croppers. The owner in the latter cases has an interest in all the crops grown, while the cropper rents land solely for the growing of tobacco and is interested in that crop alone. These differences in interest have given rise to two distinct forms of contract.

The contract with the tenant farmer commonly requires that he furnish all labor, manure, teams, cultivating and harvesting implements, and all materials necessary for stripping, while the landowner

furnishes the curing shed and sometimes the laths on which the tobacco is hung while curing. The owner receives for his pay a share of the crop, commonly one-half, and the tenant or owner may sell his share without reference to the other party.

Under the cropper's contract, the owner commonly prepares the land, furnishes the manure upon the ground, and supplies teams and implements for cultivation and harvesting, in addition to maintaining the curing shed, with its necessary supply of laths, and providing a team for the delivery of the crop after its sale. The cropper, on the other hand, spreads the manure, provides all labor necessary for growing, curing, and stripping, and provides one-half of the fuel, twine, and paper used in the stripping operation. The crop is shared equally by the two parties to the contract, each of whom may sell his share independently of the other.

In the Clinton-Lycoming district, the contract between the farmer and either tenant or cropper is essentially the cropper's contract above outlined. In this district, however, the tobacco is packed by the growers in cases containing 300 pounds, and the expense of the packing is equally divided between the farmer and the tenant or cropper.

SEED BEDS.

The selected seed is first planted early in the season in a warm seed bed and transplanted when the plants have attained proper maturity and the soil and weather have become suitable for their vigorous development.

A well-protected spot, conveniently near a water supply, is selected as the site for the seed bed. The bed usually consists of a cold frame about 8 feet wide and of any convenient length, and is made of 12-inch boards fastened to stakes driven into the ground at regular intervals. The whole bed is covered with muslin immediately after the seed is sown, in order that the young plants may very quickly be forced into a growing condition.

Some careful growers construct a number of smaller cold frames of definite dimensions and, instead of covering the whole with muslin, put glass over a part, thereby making a more efficient hotbed than the one above described. (See fig. 3.) This method is not used in the Clinton-Lycoming district.

The seed is usually sown about the first of April. Tobacco seed is considerably smaller than clover seed and is therefore very difficult to distribute evenly. A convenient way of sowing is to stir a tablespoonful of seed into a 2-gallon sprinkling can full of water and then sprinkle the water evenly upon the bed. An even tablespoonful of seed will sow about 1 square rod.

In the Clinton-Lycoming district many growers mix the seed with a convenient quantity of dry wood ashes to make a bulky mixture and then sow the mixture.

As soon as the seed is sown the muslin covering is stretched over the bed and is removed only to water the soil and to pull the weeds. In dry weather it is necessary that the beds be watered at least three or four times a week. Care must be taken that too much water is not used, since excessive moisture tends to favor various fungous diseases.



FIG. 3.—Tobacco seed beds, showing the glass removed and the cloth rolled back.

PREPARING THE SOIL.

In order to retain the soil moisture, the tobacco land is plowed early and an occasional harrowing given it up to the planting time. Before planting it is cultivated thoroughly, so as to make the soil as loose and mellow as possible. Stable manure is the chief fertilizer, horse manure being considered especially valuable, and this is sometimes plowed under and sometimes applied on top. The Clinton County growers state that since they have discontinued the use of cow manure and have used only horse manure their percentage of "calicoed" tobacco has been less. A common dressing is 10 loads per acre. The use of commercial fertilizers is increasing, but they

are not used as extensively as in Connecticut.^a Formerly the commercial tobacco fertilizers offered contained potash in the form of chlorid, with the resultant danger of injuring the burn of the cigar. Now, however, the sulphate is used and sometimes the carbonate. Tobacco stems are frequently bought from the manufacturers and used as a fertilizer.

After the plants have grown to the height of 5 to 6 inches and have developed from 5 to 7 leaves, they have reached a desirable stage for planting. Before the plants are pulled from the seed beds they should be thoroughly watered, in order that the small roots may not be torn off and that as much soil as possible may adhere to them.



FIG. 4.—A type of tobacco planter commonly used in Pennsylvania.

In drawing the young plants from the beds for transplanting, they should be taken up one at a time, and care should be exercised to see that all diseased and injured plants are discarded.

TRANSPLANTING.

The plants are set out in rows either by hand or with a planter; in the Clinton-Lycoming district exclusively by the latter method. They are set from 18 to 30 inches apart in the rows, and the rows are from 36 to 48 inches apart. The distance apart at which the plants are set depends upon the strength of the soil and also upon the variety and character of the tobacco. The plants of the Pennsylvania Broad-

^a A record of soil tests with fertilizers on Hagerstown and Conestoga loams in Lancaster County and on Susquehanna alluvium in Bradford County is given in Pennsylvania Agricultural Experiment Station Report, 1898-99, pp. 11-79.

leaf tobacco are set from 24 to 30 inches apart in the rows, and the rows are from 36 to 42 inches apart.

Throughout Lancaster County it is the common practice to transplant the tobacco crop by machinery. There are upon the market a number of machines designed for this purpose. The machine shown in figure 4 is drawn by two horses, and carries a driver and two other persons to set the plants, each person setting every alternate plant. A V-shaped plow makes an opening into which the plant is set, and it is held in place by the hand until the soil has been packed around the roots by means of a couple of paddle-shaped blades which follow the plow and draw the soil together and slightly compact it. By means of a gearing on the wheels, quantities of water are liberated at uniform distances apart. They indicate the points where the plants are to be set. The method of transplanting by machinery enables the grower to transplant in dry weather. The machine gives the soil an

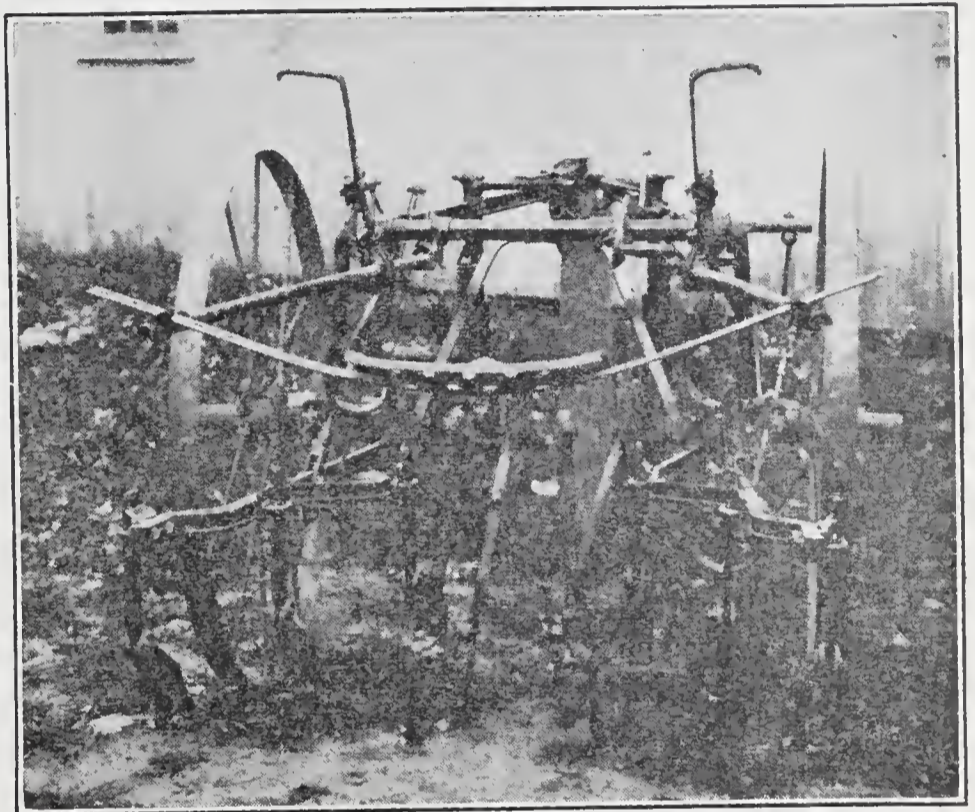


FIG. 5.—A tobacco hoeing machine.

additional working and also waters each plant at the roots. Three men with a transplanter can set as many as 1,800 plants in half a day.

Some replanting is always necessary, and this is done by hand, usually at a time when the weather conditions are favorable for starting plants.

CULTIVATION.

The field should be cultivated within eight or ten days after the plants have been set. Just recently there has been placed upon the market a machine known as the tobacco-hoer. (See fig. 5.) This machine is drawn by two horses and carries a driver and another man to operate the hoes. It is a great labor-saving device and works the soil as thoroughly as does the hand hoe.

The essential thing in cultivating is to keep a mulch on the surface of the soil, and hence the cultivation must be repeated after each rain. The hand hoe is used very extensively and also to good advantage, since it permits cultivation closer to the plant than does the ordinary horsepower machinery. In cultivating tobacco the soil is

always worked toward the plant and not away from it. The period of cultivation ceases when the leaves have become so spread out that a horse can no longer pass between the rows without damaging the plants.

TOPPING.

“The objective point in the life of a plant is the production of seed for the perpetuation of the species. When the seed head forms and develops, the nourishment is gradually transferred from the leaves and used for the formation and production of seed. In a plant like tobacco, which is valued for the quality of the leaf, it is necessary to remove the seed head as it forms, in order that the nutritive substance may remain in the leaf.”^a

The proper time for topping tobacco is a matter of dispute, but most growers prefer to top just as soon as the buds have attained such size that they can be readily seized and removed without injuring the leaves.

In cutting or pinching out the buds, care must be exercised not to injure the tender top leaves. A very slight injury will develop into a serious blemish when the leaf has attained its fullest expansion.

Just how much of the top should be removed in taking out the bud depends upon the variety of the tobacco and upon the strength and vitality of the individual plant. Strong, vigorous plants can be topped high. In the Pennsylvania Broadleaf varieties, from twelve to fifteen leaves are allowed to develop on a plant, though sometimes twenty. Since not all the plants develop their buds at the same time, it is necessary to top over the field several times. The topping is an important factor in the growing of tobacco and requires good judgment, because upon it depends to a great extent the uniformity of the crop.

SEED PLANTS.

The seed plants are selected at the time of topping in order that their top buds may be permitted to develop to maturity. The seed pods commonly ripen some time after the harvesting of the main crop, and are then removed and dried in the manner common with other small-seeded pod fruits. The yield of seed from a single plant is very great.

SUCKERING.

As soon as a plant is topped suckers begin to develop from buds in the axil of the leaf; that is, at the point where the leaf's midrib springs out from the stalk, and above, rather than below, the midrib. Suckers first appear in the axils of the top leaves, and later in those of the middle and lower leaves. In the Seedleaf and Havana varieties they are almost always single; rarely, if ever, double. In warm, moist weather they develop very rapidly. Every ounce of

^a See Farmers' Bulletin 82, 1898, pp. 17-18.

plant food and moisture spent upon them by the plant is, for the filler-tobacco grower's purpose, so much waste of material. It is therefore important that the suckers be promptly removed. This is best done by pinching the axil buds as soon as they show signs of developing into suckers. If the strain of plants grown is highly productive of suckers the fields must be suckered over every two or three days in warm, moist weather until the crop is ready for harvest. Where a leaf has been injured it is sometimes removed and a sucker allowed to develop in its stead; but the sucker rarely makes a good leaf, and usually matures much later than the main leaves, so that it introduces a source of difficulty in curing the crop. The time and care spent in suckering can be largely avoided by the selection of strains with little tendency to produce suckers. In the Clinton-Lycoming district it is the practice to sucker, or "top," as it is locally termed, but once, about ten days or two weeks before harvesting.

HARVESTING.

"The passage of the various constituents of a plant from one part of it to another as the plant advances to maturity is a capital fact common to all plants, and we see in fact that the oldest leaves gradually wither and die as they give up to the newer parts of the plant many of the matters that were contained in their cells. There comes a time when the plant ceases to draw food from the air and from the soil, and devotes itself to the purpose of concentrating the nourishment that was previously scattered through all its parts."^a

Despite the removal of its flower head, the topped tobacco plant experiences near the time usual with the seed plant a change in its leaves similar to that which goes on in the maturing of the seed, though probably with less loss of substance. The bottom or "sand" leaves, so called because of their nearness to the soil (being often bespattered with sand), have usually shrunk and yellowed, or even dropped off, while those about the middle of the stalk are still growing vigorously. The process of ripening progresses from the bottom upward.

At this period the tobacco leaves begin to change color from a dark green to a lighter shade and take on a mottled appearance. The first evidence of ripening is the change of color. The grower usually depends upon several other tests of ripeness. One of these is the thickening of the leaf, which can readily be determined by pressing it between the thumb and forefinger. In addition to thickening, the leaf takes on a distinctly leathery feeling. Another common test of filler varieties is to turn up the under surface of the leaf and fold the leaf between the fingers. when, if ripe, it will snap or crack and retain a crease.

^a See Farmers' Bulletin 82, 1898, pp. 18-19.

In some countries and in the case of some varieties the practice is to remove the leaves separately as they ripen. This process is termed "priming." Where it is practiced the stalks are left in the field and the leaves are fastened to the laths in the curing shed by impaling them upon wires or nails set in the laths or are strung upon a cord attached to the ends of the laths.

The filler tobaccos, and indeed all tobaccos generally grown in Pennsylvania, are harvested on the stalk as nearly as may be at the time when the middle leaves of the field of plants have become ripe. Vigorous plants set out about the middle of June are commonly ready to harvest by the last week in August and rarely delay their ripening

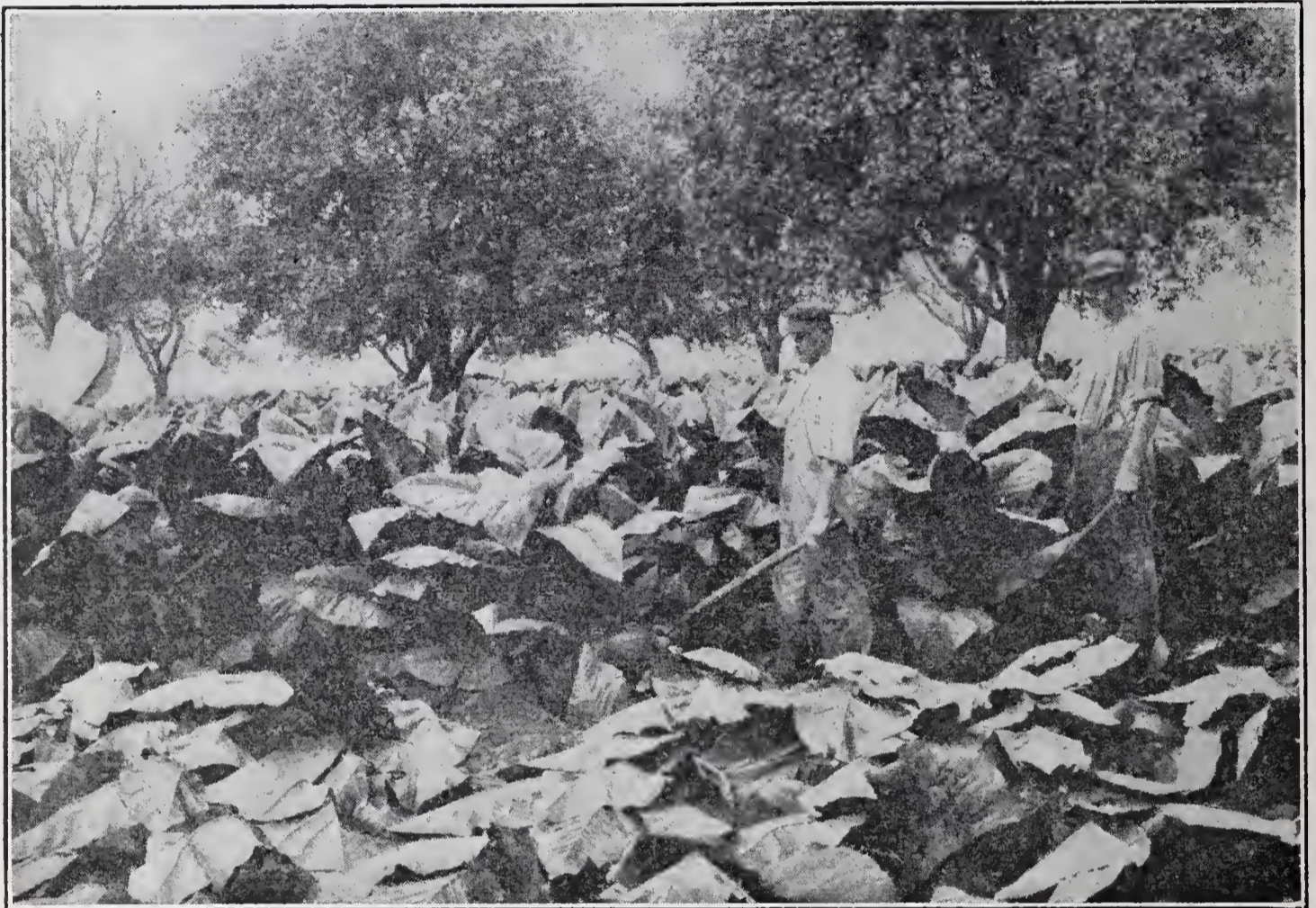


FIG. 6.—Field of tobacco, showing the method used by the harvesters in cutting the stalks with long-handled shears.

until the latter part of September, though in infrequent unfavorable seasons the grower is driven to harvest his tobacco about that time, despite the immaturity of the leaf, to avoid the fatality of a sharp frost.

When the whole plant is harvested it is cut off near the ground by means of long-handled shears made especially for the purpose and is allowed to wilt for several hours (fig. 6). In the Clinton-Lycoming district tobacco is harvested by means of a corn cutter, the plant being bent over by one hand and severed at the base by a single stroke of the cutter held in the other hand. If the sun is hot, care must be taken that the leaves do not scorch or sunburn.

As soon as the plants have wilted sufficiently to be handled without a serious breaking of the leaves, they are strung upon ordinary 4-foot laths by means of a detachable iron-pointed spear fitted to one end of the lath and made to pierce through the butt of the stem, five or six plants filling one lath. Before they are strung care should be taken to see that all the worms and suckers are removed from the plants. The suckers will continue to grow and will prevent the leaves from curing properly in the shed. Many growers before taking the tobacco to the curing shed hang it for one or two days upon portable racks (fig. 7) in order to bring the leaf to the wilted condition desired. The tobacco is then hung upon a wagon built for the purpose and is conveyed to the curing shed.

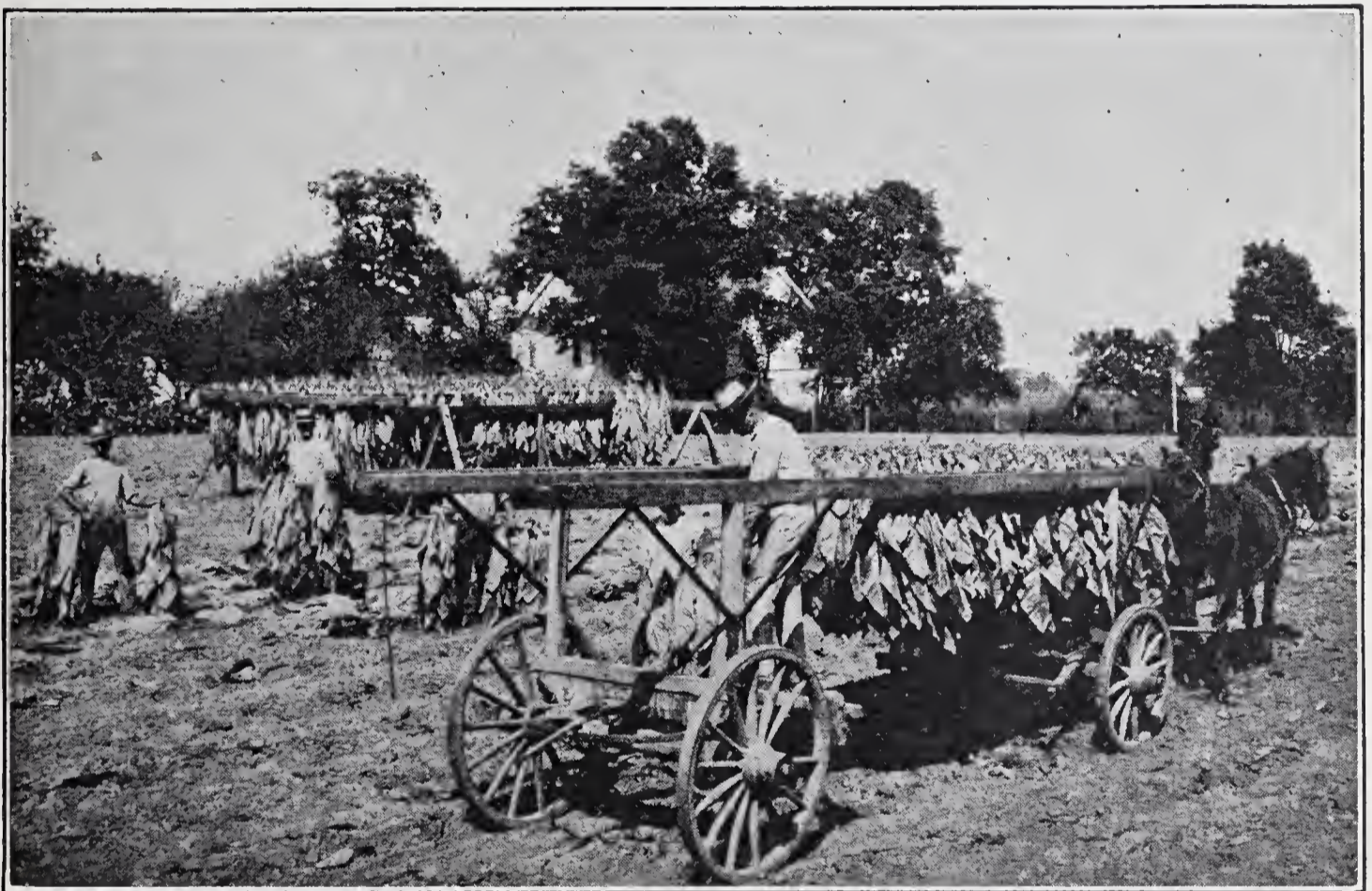


FIG. 7.—Field of tobacco during harvest, showing the way the stalks are strung on laths, the manner of scaffolding, and the type of wagon used in hauling the tobacco to the curing shed.

CURING AND HANDLING.

CURING SHEDS.

The majority of the small tobacco growers thrash out their grain early, stack their straw, and then use their barn mows and driveways for curing tobacco. The space is provided with a timber framework to support the tobacco-filled laths, which are hung, beginning near the ridgepole, side by side about 6 inches apart and in descending tiers so closely placed that a space of not more than 4 to 6 inches is left between the tips of the plants in one tier and the butts of those in the next lower tier. At the time of hanging the tobacco, care is taken

that the plants are uniformly spread upon the laths, as immediate contact of the plants may lead to the injury of the leaves in curing.

The large growers, however, usually erect separate curing sheds provided with some system for controlling the ventilation. (See fig. 8.) In some cases top ventilation is secured by means of slatted ventilators set in the gable ends of the shed or in the roof along the ridgepole, or by means of valved, cylindrical, metal ventilators set in the roof peak. In others, side ventilation is adopted and either vertical ventilators are made by inserting loose boards at intervals of a few feet along the sides of the shed, or horizontal boards, hinged above and fastened to a common vertical lifting rod, are fixed in

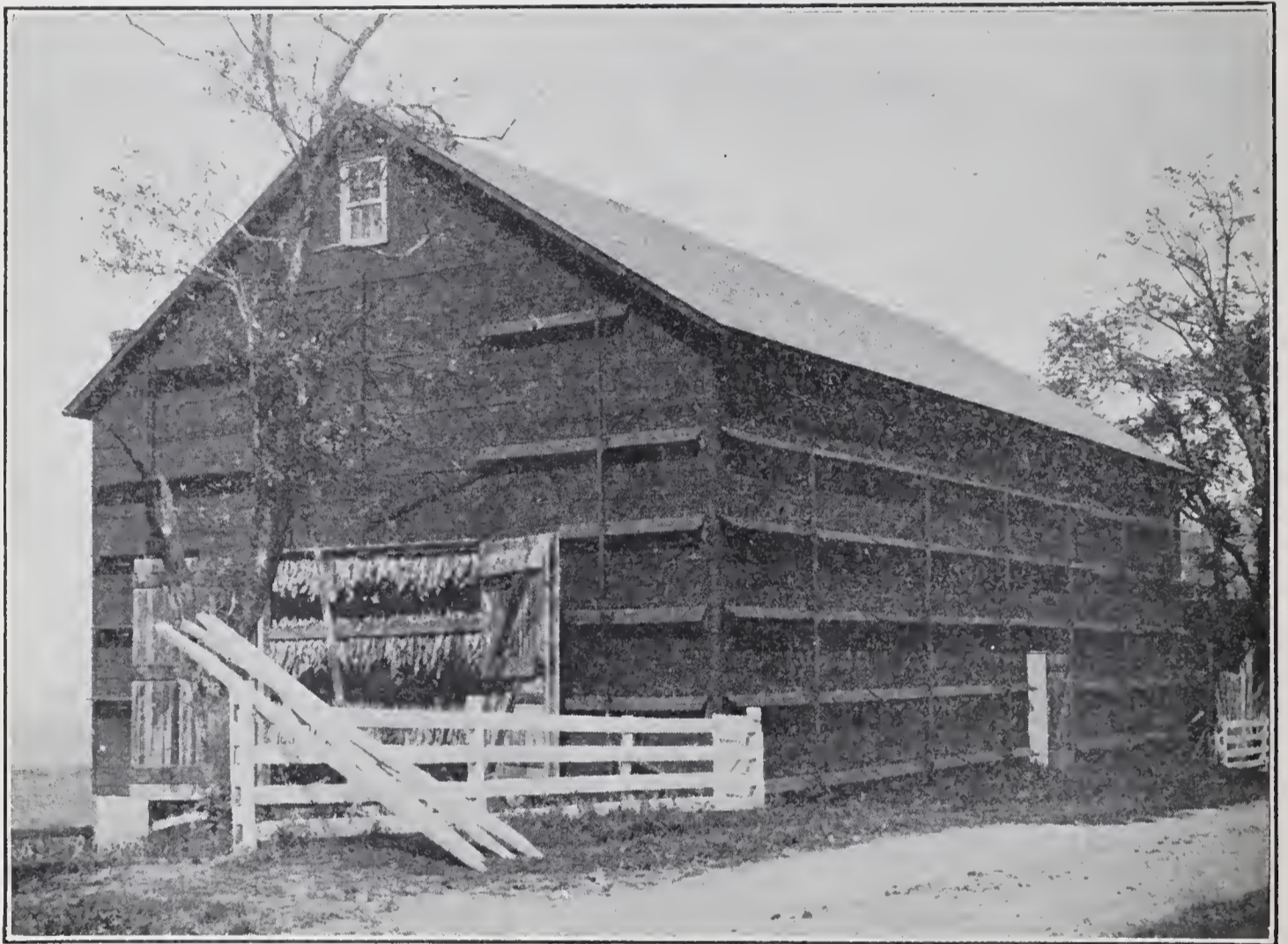


FIG. 8.—A tobacco curing shed with horizontal ventilators.

the sides of the shed at points near the lower end of each tier. In still other cases the floor beams project on each side beyond the foundation walls, and the wall plates rest upon the ends of these beams rather than directly over or upon the foundation walls. The floor between these two lines of walls consists of trap doors, which can be raised to secure bottom ventilation.

Very commonly the system adopted provides for both side and roof ventilators, each under control from the floor, or for bottom and top ventilators. Heating systems for the control of ventilation are very exceptional. In the Clinton-Lycoming district the vertical-hinged side ventilator is almost exclusively used, sometimes with the addition of a roof ventilator.

THE CURING PROCESS.^a

Tobacco in curing gives off large quantities of moisture, but the process is not a simple drying. The leaf is the seat of rapid chemical processes by which heat is developed. If the air in the sheds becomes dry the leaf becomes brittle and retains most of its green color, as well as its raw flavor and aroma. After the first ten days or two weeks, therefore, the doors must be closed, especially in dry, windy weather, and the ventilators partly or wholly shut. The loss of water from the plant is most rapid after the leaf has turned yellow.

On the other hand, there is danger as the curing progresses, and especially in rainy or in quiet, foggy weather, that the humidity of the air in the curing shed may become excessive. If the heat given off by the plants should, at the same time, elevate the temperature to between 70° and 90° F., the tobacco at any time during the first three weeks of the curing is very much subject to attack by pole-burn, which may in a single day ruin the entire crop. When, therefore, the air of the shed becomes highly moist, every effort must be made to promote ventilation, especially when the presence of a faint ammoniacal odor gives warning that pole-burn has already begun its attack.

There is every reason to believe that a heating system, such as will make possible the development of air currents in the shed in times when the outer air is moist and quiet, will enable the careful tobacco farmer to overcome the dangers from pole-burn. This is the more clearly perceived when it is recognized that at temperatures below 70° and above 90° F. the danger from pole-burn is not great, and that the tendency to attack is greatly diminished so long as the leaves can freely discharge their moisture into the surrounding air. The capacity of air for holding moisture increases very rapidly as its temperature rises. Consequently the sudden warming of air saturated with moisture not only tends to set up a circulation in foggy weather, but will enable the air to take up more moisture from the leaves and thus tide the crop over the danger point until the outer air is restored to its normally favorable condition. As already noted, Pennsylvania farmers, with few exceptions, have not availed themselves of this method of control.

While the dangers from pole-burn are confined to the earlier stages of the cure, excessive moisture in the shed at a later period is also undesirable, since it favors the development of the mold that causes white-vein.

^a For a full account of the air conditions in the curing shed and the changes in the appearance and weight of the leaf while curing by the usual Pennsylvania practice, see Pennsylvania Agricultural Experiment Station Report, 1894, pp. 208-218.

By the last of September the entire crop is usually housed, and that which was harvested first is partly cured. It is not until the middle or the last of November that the tobacco is cured off well enough to be stripped. The midrib is the last part of the leaf to lose its moisture, and until this is thoroughly dry it is not safe to begin to strip.

After the leaves are cured they are dry and brittle and can not be handled until a period of wet weather sets in, when they become damp and elastic. When in this condition the tobacco, still on the laths, is taken from the scaffold and piled compactly in heaps on the floor of the shed. It is then covered over with corn fodder to keep it from drying out. From the heaps it is taken to the dampening cellar, where it is put in the proper condition of moistness for stripping.

THE DAMPENING CELLAR.

The dampening cellar is often located under the curing shed; in other cases it is a portion of the barn basement, walled off from the stables. It is commonly adjacent to a well-lighted stripping room, which is provided with a stove, so that the room may be kept comfortable for work during the colder winter weather. The cellar usually has an earth floor, which may be sprinkled as need may arise, thus keeping the air sufficiently humid to put the tobacco rapidly in case for stripping. The best dampening cellars are almost entirely below the ground level and have their floors several feet lower than those of the neighboring stripping rooms.

In the Clinton-Lycoming district all growers use cellars in preparing their tobacco for stripping.

ARTIFICIAL MEANS OF DAMPENING.

Considerable difficulty is frequently encountered in getting a sufficient quantity of tobacco into the proper condition of moistness to keep busy the men in the stripping room, and therefore the farmer sometimes deems it necessary to use artificial means of dampening. Various methods are practiced. The easiest is to sprinkle lukewarm water over the butts of the stalks after the tobacco has been hung in the cellar. A less harsh method is to have a water boiler on the stove in the stripping room and to force the steam from this into the dampening cellar. The steam is allowed to escape near the floor and on rising dampens the tobacco.

All artificial means of dampening are, in general, condemned by the packers, because of the rot which the excessive moisture will probably cause while the tobacco is sweating.

A properly constructed cellar with a capacity of 500 or 600 laths should, under ordinary conditions, without any artificial means of

dampening, keep four strippers working continuously. It is necessary, however, that the cellar be filled each day from the shed, since the tobacco must hang in the cellar at least thirty-six hours to become fully damp.

STRIPPING AND SORTING.

From the dampening cellar the tobacco is taken to the stripping room, where the stalks are removed from the laths and then stripped of the leaves.

The leaves are usually sorted into two grades, commonly called "fillers" and "wrappers," although, as previously stated, the latter are chiefly used for filler purposes. For the fillers are taken all the lower or sand leaves and for the wrappers all the other leaves free from blemishes. Sometimes three grades are made. In the Clinton-Lycoming district but two grades as to length and quality are used, while in the Bradford-Tioga district some growers make but one grade of sound tobacco. The tobacco is then tied up in hanks or bunches of 15 to 20 leaves each. The leaves in the bunches are tied together by wrapping a leaf about the butt ends.

The hanks are usually tied up in bales of about 50 pounds each. In the Bradford-Tioga district the bales are not uniform in weight, but range from 25 to 50 pounds. The bales are wrapped in heavy paper with the ends open and are tied with three or four hemp twines.

It is in this shape that the tobacco is sold to the packer. In the Clinton-Lycoming district, however, the tobacco is delivered to the packer in the case and a tobacco press is commonly used in filling the case. There are two ways in which tobacco in this shape is generally sold. One way is on the basis of so many cents a pound for the wrappers and so many cents a pound for the fillers. The other way is on the basis of so much a pound for every pound in the crop. The latter method is almost universal in the Clinton-Lycoming district.

COST OF PRODUCTION.

In a survey made by the writers in 1908 to ascertain the cost of production of Seedleaf tobacco^a on a number of the better conducted tobacco farms of Lancaster County, it was found that the cost per acre, including the rental value of the land and buildings, the depreciation of equipment, the expense of preparing the land in its manured state, of planting, cultivating, harvesting, curing, stripping, and preparing the crop for market, and of delivering it to the railway, ranged from \$90.07 to \$126.74, averaging \$112.42.

^aA complete report of this survey appears in the Pennsylvania Agricultural Experiment Station Report for 1908-9, pp. 185-198.

The yields upon the farms studied ranged from 1,075 to 2,267 pounds per acre, averaging 1,639 pounds. The cost per pound of stripped tobacco, calculated from the corresponding cost and yield per acre, ranged from 4 cents to 11.3 cents, averaging 7.4 cents.

It was found that intensive cultivation, and especially the use of a vigorous strain of plants, so greatly increased the yield as to keep the cost per pound near the lower point.

TOBACCO DISEASES AND ENEMIES.

From the time the seed is planted until the tobacco is ready for manufacture it is running the gauntlet of a succession of diseases and enemies.

The covers of the seed bed to some degree protect the young seedlings from attacks by beetles, but the snail is often very destructive, eating off the young leaves as they develop.

Immediately after transplanting, the cutworms begin their ravages. The custom of placing bran or green vegetable material mixed with arsenical poison at frequent intervals along the row is found quite efficient in destroying these worms.

Frenching and "foxy" tobacco sometimes appear, the latter especially in unfavorable seasons; likewise the rust. Against these fungi and diseases no remedy has been found efficient, which is also true of the rather frequent instances of the mosaic disease.

In Pennsylvania, as in all other American tobacco regions, the large hornworms, or tobacco worms, several inches in length, begin their attacks not long after transplanting and sometimes devour all but the stalk and midribs of the plant. Removal by hand and constant vigilance are relied on in this section as preventives of the serious injuries these worms quickly accomplish. Here and there tobacco farmers give the growing crop, some weeks before the time of harvest, a spraying with some arsenical poison.^a This greatly assists in combating the attacks of leaf-biting insects. Subsequent rains often remove the evidences of such applications. Flea-beetles, grasshoppers, crickets, and stinkbugs often work considerable injury by perforating the leaf, and the budworm occasionally hollows out the flower buds so as to prevent seed formation. Constant inspection of the tobacco and the removal of these leaf eaters is essential to success.

Immediately after the tobacco is hung in the curing shed the danger from pole-burn begins. The means now used for preventing or controlling this disease, from which few crops wholly escape, have been mentioned in the discussion of curing. The disease appears to

^a For methods of applying arsenical poisons and for other remedies for the control of the hornworms and other tobacco insects, see Farmers' Bulletin 120 and Circular 123, Bureau of Entomology, U. S. Dept. of Agriculture.

be due to the successive action of associated molds and bacteria, for whose destruction no means applicable to the conditions are known. Pole-burned leaf turns dark brown, is wet and soggy, easily torn, and has practically no value. White-vein,^a which may appear later in the curing, is a white mold which attacks not only the midrib of the leaf but also the adjacent web and causes it to become tender and rotten. The spores of this disease remain in the dust and trash of the curing shed, but they can be almost entirely overcome by cleaning and fumigating the shed before harvest.

Finally, the tobacco in the case is often attacked by molds which make it musty and by black-rot, the cause of which is not thoroughly known. The black-rot, as its name implies, is the cause of masses of leaf in the interior of the case turning black and becoming tender, so that the leaves are unavoidably torn in the handling. While musty tobacco unfavorably affects the flavor and aroma of the cigar, it is a matter of general observation that the cigars from tobacco affected by black-rot often possess a peculiarly pleasant aroma.

Care in preventing the harvesting of green tobacco, the development of mold during the curing, the packing of tobacco when it is in too "high case"—excessively moist—and its overheating are the only means of prevention now known for the foes here considered.

CULTURAL METHODS DESERVING SPECIAL CONSIDERATION BY THE TOBACCO GROWERS OF PENNSYLVANIA.

(1) The use of catch crops, such as wheat, rye, or sand vetch, after corn or between succeeding crops of tobacco, to keep the soil in a spongy, fertile condition.

(2) The separation by blowing in an appropriate apparatus^b of all tobacco seed, so that the light seed, which is generally worthless and productive of weak plants, if it germinates at all, shall be wholly removed.

(3) The testing of the heavy seed obtained by blowing by a preliminary germination. This is especially desirable when old seed is to be used or that which has been harvested, as is sometimes necessary, before it has completely ripened in the pod. Concerning old seed, it may be remarked that the vitality of some individual tobacco seeds is of many years duration, a fact of much importance where it is desired to return to the original characters of a strain or where seasonal conditions have for several years been unfavorable to the

^a These diseases are more fully discussed in Pennsylvania Agricultural Experiment Station Report, 1894, pp. 201-206.

^b The method used in separating the heavy from the light, less perfect seed is described in the Yearbook of the Department of Agriculture for 1904, pp. 440-442.

best development of the corresponding seed crops. Long keeping lowers the vitality of the average seed, however, and the use of seed of uncertain vitality may risk the entire season's work.

(4) The careful selection of seed plants. This is of the greatest importance. Tobacco self-fertilizes for years without apparent loss of vigor. Cross-fertilization may be prevented by fastening a bag of stout paper over the flower head before the blossoms open, without injury to the seed pods, if the bags are perforated with fine openings so as to secure ventilation. (See fig. 2.) The bags can readily be perforated by means of an ordinary sewing machine, no thread being used in the needle. The seed from self-fertilized plants



FIG. 9.—Field of tobacco, showing a banner crop of Pennsylvania Seedleaf. The seed for these plants was carefully selected, bagged, and separated by blowing in a seed grader.

produce offspring of remarkable uniformity and similarity to the parent plant. (See fig. 9.) Propagation from the seed of carefully selected, self-fertilized plants is a highly valuable means, therefore, of securing uniform plants of the most desirable quality represented in the crop from which the selection is made. It is clear also that lack of care in the selection of seed plants, whether they are self-fertilized or not, will probably result in the maintaining of an inferior strain of the variety chosen for cultivation.

By careful selection it has been found possible to limit the propagation to the plants most vigorous in growth, most highly resistant to the fungous diseases that appear in the field, having the least tendency to wasteful suckering, and of the most desirable form.